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| (54) Title: COLD BREW TEA | | |
| (57) Abstract | | |
| <p>A cold water infusible tea leaf product is disclosed which brews in cold water to produce an iced tea beverage with the color and flavor of iced teas prepared by hot brewing methods. The product when brewed in water at about 15 °C for about 5 minutes at a water to tea ratio of 100 water to 1 tea has a cold water infusion Hunter L Value of about 25 to 45; a Hunter "a" value of about 24 to 34; a Hunter haze value of less than 40 and at least 0.15 % soluble tea solids.</p> | | |

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COLD BREW TEA

The present invention generally relates to a cold water infusible tea leaf, to processes for obtaining such leaf and to the improved cold water infusion products thereby obtained.

Background

Black tea is traditionally produced from fresh green tea leaves (*Camellia sinensis*) by a process comprising four major steps: withering, rolling, fermentation and firing. Withering is a process whereby the freshly plucked green tea leaves are stored until the moisture content is reduced to about 55-72% of the leaf weight. The withered leaves are crushed by rolling or maceration in order to break down the leaf cell structure and bring enzymes and the substrate polyphenols into contact. During fermentation the simple flavonoids in green tea leaf are oxidized by endogenous tea enzymes to produce the polyphenols that impart a bright red color and the astringent flavor to black tea. Tea fermentation is truly an enzymatic process and is not the typical fermentation used in brewing of alcoholic beverages. Two enzymes, polyphenol oxidase and peroxidase catalyze the oxidation of simple catechins to the more complex polyphenols; namely theaflavins (TF) and thearubigens (TR).

Fermented teas are fired (dried) with hot, dry air reducing the moisture content of the leaves to less than 5%. Firing of teas arrests fermentation by inactivating enzymes and results in development of color and flavor from chemical oxidation and creates the final balance of tea aroma. Following drying, the leaves are then sorted and graded to yield a commercial black tea product. The process of tea manufacture is described in great

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detail by Robertson 1992 (*Tea: Cultivation to Consumption*. Wilson, K. C. and Clifford, M.N., Eds., Chapman Hall, London)

5 Tea beverage is prepared from the black tea leaf manufactured by the above process by infusing the tea leaves loose or in a tea bag in hot freshly boiled water for a few minutes. After removing the tea leaf, the beverage is then consumed hot or cold as iced tea.

10 It is well known that the majority of the tea consumed in the U.S. is iced tea prepared by cooling down tea beverage brewed using hot freshly boiled water, by dissolving instant tea powders in water or in the form of ready-to drink teas in cans, bottles or cartons. Iced tea prepared from tea leaf with boiling water has the fresh brewed tea flavor/astringency enjoyed around the world. However,
15 the steps of boiling water and cooling down can be time consuming, generally taking more than 30 minutes before the ice tea beverage is ready for consumption.

20 Convenient as cold water soluble tea powders can be, for many consumers the quality of the final beverage is not equal to that prepared from hot infused leaves. Many consumers prefer not to use instant tea powders as they perceive them to be lacking the fresh brewed tea taste and of inferior quality.

25 Accordingly, a leaf tea that can rapidly infuse in cold water to produce an iced tea beverage with the color and flavor of the traditionally hot brewed iced tea would offer the consumer a convenient option to both traditional leaf tea and powdered tea products. The benefit of a cold brew tea product is two folds, the
30 convenience of not having to boil water and wait for it to cool down, and the fresh brewed tea taste.

There are numerous methods for making cold water soluble tea powders including U.S. 4,051,264 and U.S. 3,812,266. European

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patent specification EP 760,213 A1 (Unilever) discloses a method of enhancing color in a tea-based foodstuff. The method involves using a tannase pre-treatment (on leaf or extract) followed by treatment with exogenous peroxidase and hydrogen peroxide to generate cold-soluble color.

International patent publication WO 97/40699 (Unilever) concerns tea processing with zeolites to generate color. There are examples of adding zeolite following tannase treatment to generate cold-water soluble tea.

U.S. 4,639,375 discloses treating black tea with tannase, together with other cell-wall digesting enzymes, to generate cold-water soluble instant tea powders.

When conventional teas are extracted with cold water for short periods of time (less than 15 minutes), the tea beverage produced has a low concentration of extractable tea solids, a Very light color and almost no tea-like taste. Water at temperatures of about 100° C is usually employed to obtain a satisfactory beverage with prior art tea leaves.

It has now been discovered that by appropriate selection of tea leaves, which are, in turn, subjected to appropriate processing, a cold brew tea beverage can be obtained. It is now possible to obtain a leaf tea that rapidly infuses and remains soluble in cold water to give a beverage with good color and flavor that is as acceptable to consumers as iced tea made from a hot infused black leaf tea. Furthermore, this product can be made from infusions of tea obtained by modifying the traditional black tea manufacturing process.

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Statement of the Invention

In broad terms the invention relates to a cold brew tea beverage prepared by the cold brew method said beverage having taste and color parameters so that

- i. when a Q.D.A. test is performed evaluation Bitter2 and Red, and
- ii. when Bitter2 is plotted on a Q.D.A. map as the Y axis and red is plotted on said map as the X axis

the beverage has a Q.D.A. score on or above the line defined by:
 $\text{Bitter2} + 0.639 \text{ Red} \geq 4.8$.

The inventive product is used to prepare a beverage with good color and taste by infusion in cold water. The product is comprised of 100% tea leaves and excludes the addition of instant tea powder or the coating of tea extracts onto the tea leaves. In other embodiments, the product may employ powders, extracts or colorants. The product infuses in cold water and can be used to produce an iced tea beverage with the color and flavor comparable to iced teas prepared by hot brewing methods.

In summary, this invention encompasses a tea leaf product that rapidly brews in cold water to produce a beverage with color and flavor characteristics substantially identical to hot brewed iced tea beverages and a process of manufacturing cold infusing black tea leaf. This product and processes for its preparation will be described in detail in the "Detailed Description of the Invention".

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"Tea" for the purposes of the present invention means leaf material from *Camellia sinensis* var. *sinensis* or *Camellia sinensis* var. *assamica*. It also includes herbal teas such as rooibos tea obtained from *Aspalathus linearis*, however, most herbal teas are a poor source of endogenous fermenting enzymes. "Tea" is also intended to include the product of blending two or more of any of these teas.

"Leaf tea" for the purposes of this invention means a tea product that contains leaves of one or more tea origins in an uninfused form.

"Cold water infusible" for the purposes of this invention means giving good color, flavor and mouthfeel in a short infusion time, i.e., less than 10 minutes, but preferably within 5 minutes at a temperature at or below about 15° C.

As used herein, the word "comprising" is intended to mean including but not necessarily "consisting essentially of", "consisting of" or "composed of". In other words, "comprising" the listed steps or options need not be exhaustive.

Except in the examples, or where otherwise explicitly indicated, all numbers in this description indicating amounts of material or conditions of reaction, physical properties of materials and/or use are to be understood as modified by the word "about." All amounts are by weight of the composition, unless otherwise specified.

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Detailed description of the invention

Evaluation of Cold Brew Product by Sensory Descriptive Analyses
i.e. Qualitative Descriptive Analysis (or Q.D.A.)

5

The color and flavor, including mouthfeel, of iced tea beverages govern their acceptability. A Qualitative Descriptive Analysis (Q.D.A.) test method was selected to systematically characterize and quantify tea beverages based on color, flavor, and mouthfeel.

10

The Q.D.A. method employs a trained panel of expert tasters to quantify the color, flavor and mouthfeel attributes of iced tea beverages relative to defined reference standards.

15

Expert tasters were chosen by screening prospective panel members for ability to taste standard solutions of acid (citric acid), salt (sodium chloride), sweet (sucrose), and bitter (caffeine) that represent high to low levels (grams per liter) of each flavor attribute as defined in the following table.

| Acid | Bitter | Salt | Sweet |
|------|--------|------|-------|
| 0.6 | 0.5 | 2.0 | 12.0 |
| 0.4 | 0.3 | 1.0 | 4.3 |
| 0.2 | 0.2 | 0.5 | 1.6 |
| 0.1 | 0.1 | 0.2 | 0.5 |

20

Individuals who were able to identify and differentiate the flavor of each test solution at the lowest concentration qualified for participation as an expert taster and were trained to describe and quantify tea beverages using a defined set of attributes to describe color, flavor and mouth feel.

25

Through a mathematical technique known as Principle Component Analysis four attributes, bitterness (also called bitterness2 or bitter 2 in this application which refers to the bitter aftertaste rather than initial bitterness), smoothness, redness and

30

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yellowness were found to be useful for differentiating iced tea beverages. Expert panelists (a minimum of eight) were selected and trained to describe iced tea beverages by rating the intensity of each key attribute (bitterness, smoothness, redness, and yellowness) on a scale of 1-10 by exposing the tasters to extremes of each attribute. For example an infusion of whole leaf Darjeeling tea may be used to define bitterness and yellowness and an infusion of Argentine tea may be used as an example of redness and smoothness. Once trained the expert tasters were tested through blind evaluations of iced tea beverages representing low to high levels of each attribute, provided in random order. Expert tasters evaluated each sample at least 3 times to be assured that panelist ratings were consistent and reproducible. To determine the range of attributes that defines hot brewed iced teas, a variety of teas that represent a broad sampling of the world of teas were evaluated by the trained panel after being prepared by three distinct methods of brewing. All of the water was carbon-filtered tap water. Brewing Method 1 (full flavored brew method) involved the preparation of a concentrate followed by dilution to final beverage strength. Six pitcher or family size tea bags each containing about 7.13 grams of tea leaf were brewed in two quarts of hot freshly boiled water for 30 minutes followed by dilution to beverage strength with an additional two quarts of cold water making a gallon of beverage. Brewing Method 2 (mild flavored brew method) was a single strength infusion rather than a concentrate preparation. In contrast to Method 1, the tea bags were brewed with the full amount of boiled water (four quarts) for three minutes. Brewing Method 3, designed for the cold brew tea leaf product, was used for the preparation of the inventive product and all reference teas. Six pitcher or family size tea bags were infused in one gallon of cold (60° F or 15°C) carbon filtered water by dunking the bags several times each minute during the 5 minute brewing time.

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Product evaluations were conducted in Sensory booths where the trained expert tasters ranked the teas on a 1-10 scale for bitterness, smoothness, redness, and yellowness. The samples were served blind, identified only by a three-digit code and presented in three replications using a balanced block design. Flavor assessment was done under red lights. Appearance was done under white light. The result of this type of test over several different panels, while possibly not being an exact match as to absolute values, will still statistically show the same relative differences between the products.

The teas may be distinguished as those which when cold brewed are poor in color or flavor and are generally lacking in the desirable tea attributes as compared to the teas of the invention having good color and taste and generally attributes that are like those of hot brewed teas. The method for defining the teas is as follows: by plotting each color attribute (red or yellow) vs. a mouthfeel attribute (bitter or smooth), using averaged scores of the panelists, plots are produced which show the inventive teas as superior to other cold brewed teas.

The groupings that result indicate that the world of teas along with the described inventive tea fall in a region of the graphs that is distinct from simply cold brewing all other teas in the data set. The defining region of the group, or Q.D.A. map that relates to the invention, is shown in figures 1, 2, 3 and 4 where teas lying in the region defined by equation 1, 2, 3 and 4, describe the area of applicants' invention. The teas lying outside of this defined region represent cold brewed teas selected from the world of teas that lack the preferred qualities by comparison. The type of tea, the method of brewing and the data points produced by the Q.D.A. analysis are reported in Table 1 below.

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TABLE 1

Tea type; Brewing Method; Q.D.A. Score

| Samples | | Average of Q.D.A. Attributes | | | |
|---------|-------------------------------------------------------------------|------------------------------|---------|-----|--------|
| ID | Description | Smooth | Bitter2 | Red | Yellow |
| #01 | Cold Brew Tea (Tannase Peroxide process) 5 min. cold brew (Ex. 1) | 8.0 | 2.4 | 8.0 | 2.3 |
| #02 | Cold Brew Tea (Alkal. treatment process) 5 min. cold brew (Ex. 2) | 8.3 | 1.8 | 9.6 | 1.2 |
| #03 | Lipton® Cup - 3 minute hot brew | 7.3 | 4.2 | 5.5 | 4.5 |
| #04 | Lipton® Family - 3 min. hot brew | 7.2 | 3.6 | 5.8 | 4.3 |
| #05 | Luzianne® - 3 minute hot brew | 7.8 | 2.5 | 6.6 | 3.5 |
| #06 | Kenyan - 3 minute hot brew | 6.6 | 4.8 | 4.5 | 5.5 |
| #07 | Superdust - 3 minute hot brew | 6.9 | 3.9 | 8.5 | 1.9 |
| #08 | Ceylon - 3 minute hot brew | 6.3 | 5.3 | 3.6 | 6.4 |
| #09 | Assam - 3 minute hot brew | 6.4 | 4.4 | 5.2 | 4.9 |
| #10 | Darjeeling - 3 minute hot brew | 4.7 | 6.3 | 2.5 | 7.7 |
| #11 | Lipton® Cup - 30 minute hot brew | 6.9 | 4.0 | 4.5 | 5.5 |
| #12 | Lipton® Family - 30 min. hot brew | 7.3 | 3.4 | 6.5 | 3.6 |
| #13 | Luzianne® - 30 minute hot brew | 7.8 | 2.7 | 6.0 | 4.1 |
| #14 | Kenyan - 30 minute hot brew | 6.4 | 4.3 | 6.1 | 4.0 |
| #15 | Superdust - 30 minute hot brew | 7.4 | 3.3 | 6.2 | 3.9 |
| #16 | Ceylon - 30 minute hot brew | 6.5 | 5.0 | 2.4 | 7.9 |
| #17 | Assam - 30 minute hot brew | 6.6 | 4.5 | 5.1 | 4.9 |
| #18 | Darjeeling - 30 minute hot brew | 5.2 | 6.4 | 1.8 | 8.8 |
| #19 | Lipton® Cup - 5 minute cold brew | 9.0 | 1.5 | 1.3 | 9.4 |
| #20 | Lipton® Family - 5 min. cold brew | 8.7 | 1.6 | 2.0 | 8.6 |
| #21 | Luzianne® - 5 minute cold brew | 8.4 | 1.5 | 1.3 | 9.6 |
| #22 | Kenyan - 5 minute cold brew | 8.9 | 1.7 | 2.7 | 7.4 |
| #23 | Superdust - 5 minute cold brew | 8.5 | 1.7 | 1.6 | 8.8 |
| #24 | Ceylon - 5 minute cold brew | 8.1 | 2.5 | 2.6 | 8.0 |
| #25 | Assam - 5 minute cold brew | 8.8 | 1.5 | 1.6 | 9.3 |
| #26 | Darjeeling - 5 minute cold brew | 8.0 | 2.2 | 1.0 | 10.0 |

5

Figures 1 through 4 generally represent Q.D.A. maps comparing selected aspects of the tea as measured by the panelists.

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Brief Description of the Drawings

The Data from Table 1 depicted graphically:

5 Figure 1 is a plot of Red vs. Bitter2. The inventive area on the map is represented by the area on or above the line defined by the Equation $\text{Bitter } 2 + 0.639 \text{ Red} \geq 4.8$.

10 Figure 2 is a plot of Red vs. Smooth. The inventive area on the map is represented by the area on or below the line defined by the Equation $\text{Smooth} - 0.361 \text{ Red} \leq 6.8$.

15 Figure 3 is a plot of Yellow vs. Bitter2. The inventive area on the map is represented by the area on or above the line defined by the Equation $\text{Bitter } 2 - 0.605 \text{ Yellow} \geq -1.8$.

20 Figure 4 is a plot of Yellow vs. Smooth. The inventive area on the map is represented by the area on or below the line defined by the Equation $\text{Smooth} + 0.342 \text{ Yellow} \leq 10.5$.

25 In Figure 1 samples 1 and 2, the inventive products, fall in the area defined by high quality hot brewed teas with good color and taste. The commercial teas brewed cold fall in a separate area below the line.

30 In Figure 2 samples 1 and 2, the inventive products, fall in the area defined by high quality hot brewed tea with good color and taste. The commercial tea brewed cold falls in a separate non-preferred area above the line.

In Figure 3 samples 1 and 2, the inventive products again fall with the high quality hot brewed teas. This graph is the mirror image of Figure 1.

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In Figure 4 samples. 1 and 2, the inventive products fall with the high quality hot brewed teas. This graph is the mirror image of Figure 2.

- 5 When the product is subjected to the Qualitative Descriptive Analysis test (Q.D.A. test), the inventive products will fall in certain areas of Figure 1 as defined by the equation where the bitterness2 score plus 0.639 times the redness score is greater than or equal to 4.8 ($\text{Bitter2} + 0.639 \text{ red} \geq 4.8$). In Figure 2,
- 10 the inventive products fall in the area where the Smoothness score minus 0.361 times the redness score is less than or equal to 6.8 ($\text{Smooth} - 0.361 \text{ red} \leq 6.8$).

Figures 3 and 4 are similar.

15

- Each time a Q.D.A test is run the following teas are to be included as standard reference controls: Ceylon, Assam, Superdust, Kenyan, and Darjeeling brewed as described in the methods. The Q.D.A. attributes for these teas should match those in Table 1
- 20 plus or minus 10%. If these values are not within this range the results of the panel are to be considered invalid for defining the cold brew product.

25 Processes for Preparing Cold Water Infusible Leaf

- There may be many methods of preparing tea leaves that infuse in cold water. This invention describes processes for preparing black tea leaf that unlike conventional black tea leaf, when infused in
- 30 cold water, produces tea with color and taste superior than using conventional black leaf for cold infusion.

One method, which is preferred, is a tannase peroxide method described in a companion co-pending application T98-034(C).

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Tannase/Peroxide Process:

When conventional tea leaves are extracted with cold water for short periods of time (less than 15 minutes), the tea beverage
5 produced has a low concentration of extractable tea solids, a very light color and almost no tea-like taste.

In a preferred embodiment of the method, freshly plucked green tea leaves are withered and macerated in the normal way using any of
10 the techniques known to those skilled in the art of tea manufacturing.

In a first departure from traditional black tea manufacture, the macerated leaves are treated with tannase (flavanol gallate
15 esterase) to generate degallated catechins and gallic acid. This subsequently leads to the generation of theaflavins, epitheaflavins acids and non-gallated thearubigens during fermentation (which are more cold water soluble than the gallated ones).

20 The general reaction catalyzed by tannase is the cleavage of gallate ester linkages, both on gallated catechins and also from other gallated compounds within the leaf. Tannase is also well known to improve the clarity of tea products since galloyl groups are important in tea cream formation and tannase has been used
25 extensively for the degallation and solubilization of black tea cream. The tea is fermented under solid state conditions.

The tannase can be applied using a variety of known techniques. It is preferred to dissolve tannase in water, spray the solution
30 onto the macerated tea or dhool and leave the mixture to react for a suitable time at suitable fermentation temperatures. The tannase is applied to the dhool after an initial maceration (for example, a first CTC cut) in a fine spray followed by subsequent cutting (for example, a second or third CTC cut) to ensure

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- adequate mixing. The dhool is preferably incubated under vacuum or under anaerobic conditions for example in an atmosphere of nitrogen to prevent fermentation. It is preferable that complete degallation takes place before fermentation starts as this results
- 5 in maximal formation of gallate ester free theaflavin, epitheaflavic acids and thearubigens during the subsequent fermentation, which in turn leads to optimal cold soluble color generation.
- 10 A method has been developed for bringing certain exogenous compounds into contact with endogenous compounds found in tea. This involves vacuum infiltrating macerated tea leaves with those exogenous compounds to modify certain properties of tea and tea based beverages. For example, an infusion of tannase pre-treated
- 15 tea has been found to have more than double the total theaflavin content of a control and a six-fold increase in theaflavin 1.

Vacuum infiltration is a technique that is often used in the preparation of protoplasts from plant tissue, albeit to introduce

20 substances between rather than into cell walls. Cut tea leaf tissue is incubated in a solution containing tannase. The suspension is then placed under vacuum and air is drawn from the intracellular spaces of the leaf particles, the enzyme solution is drawn in to replace it. It has been found that a vacuum of less

25 than 100 mbar is suitable for this.

The major constraint when applying this method to tea dhool is achieving access within the cells. Another major problem is that large volumes of water can seriously affect the quality of the tea

30 by reducing oxygen uptake during fermentation. Vacuum infiltration is a useful tool for introducing enzymes, for example tannase, into solid state dhool. When fermented, tannase treated dhool gives rise to black tea with high levels of theaflavin and no gallated species. This enables one to produce a range of novel

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- teas. Vacuum assisted tannase treatment is much more effective in removing gallated species and enhancing additional theaflavin formation than the equivalent treatment under ambient temperature and pressure. The vacuum allows the enzyme to penetrate the tissue and remove gallated species prior to fermentation, the key feature of tannase driven theaflavin enhancement, compared to simply applying the enzyme onto fermenting dhool and mixing in by hand.
- 5
- 10 If at all possible the conditions should be adjusted to prevent any fermentation prior to or during tannase treatment. This can be achieved by using a stronger vacuum pump, holding the dhool under N₂ sparge or shortening the tannase treatment.
- 15 Tannase can be applied to the macerated tea by a simple dosing. However, spraying the tannase in a fine mist is preferable as it aids infiltration.
- Suitable conditions can be readily determined by experiment. Good results have been obtained with tannase in an amount of 10 mg/kg dhool but preferably between 40 and 80 mg/kg dhool. The activity of tannase is 50,000 units per gram.
- 20
- 25 Fermentation is preferably carried out at a pH in the range of 4.0 to 6.5. The fermentation temperature is preferably in the range 15 to 40° C. Fermentation is preferably carried out for a time in the range 30 to 150 minutes, more preferably 105 to 120 minutes.
- 30 Furthermore, in a second departure from traditional black tea manufacture hydrogen peroxide is added, after a time that is sufficient to generate gallic acid and theaflavin during the fermentation step, to activate (or at least greatly enhance the activity of) endogenous tea leaf peroxidase.

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Tea is known to contain natural peroxidase at high levels. It is also known that natural peroxidase can be activated (or have its activity enhanced) through the addition of hydrogen peroxide in a slurry system. J. Sc. Food Agric. vol. 32, p 920-932 (Dix., 1981)

5 discloses such a system and process. The article mentions that peroxidase can oxidize tea polyphenols to form theaflavins, and also thearubigens that may be similar and different to those produced under "normal" fermentations. However, it does not offer any detailed understanding as to the chemistry at work.

10

It has been found that the endogenous peroxidases have the potential to oxidize catechins to theaflavins and thearubigens, convert theaflavins to thearubigens and, unlike endogenous polyphenol oxidase, readily oxidize gallic acid to form

15 epitheaflavic acids. The combination of these reactions generates significant amounts of colored compounds that are soluble in cold water.

The hydrogen peroxide is added in an amount that is sufficient to
20 activate endogenous peroxidases and oxidize gallic acid liberated by the tannase treatment. One skilled in the art can determine that by experiment. It is preferred to use between 100 and 200 ml of 2.0 to 2.5% hydrogen peroxide per kg dhool, but preferably 160 ml of 2.0% hydrogen peroxide per kg dhool. Under normal
25 conditions of tea manufacture, peroxidase is largely inactive, due to the low endogenous levels of hydrogen peroxide and high activities of catalase. Measurements have shown that all added hydrogen peroxide is consumed during the process, with none remaining in the final made tea. In contrast to the findings
30 disclosed in the aforementioned U.S. 4,051,264, it has been found that the combination of tannase treatment and subsequent activation of peroxide is critical for the manufacture of a product that gives good color and acceptable taste. Product that was only tannase treated had a "sour" or "metallic" note and dose

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not produce a tea beverage with acceptable color when brewed in cold water.

The method of the invention will now be described with reference to Example 1.

EXAMPLE 1

10 Lab scale process

Process steps - 60 mg tannase dissolved in 24 ml water was sprayed onto 100 g of frozen dhool. The dhool was then thawed under N₂ and once it had reached 20° C, it was placed under vacuum (50 mbar) for 60 minutes. The dhool was then fermented for 60 minutes at 25° C, 100% RH. After fermentation the dhool was sprayed with 12.5 ml ~2% hydrogen peroxide solution, placed under vacuum for 15 minutes and then dried by a fluid bed drier. One can increase the level of theaflavins by pre-treating the dhool with tannase. Peroxide is added to activate the endogenous tea peroxidase. This enzyme oxidizes theaflavins and the gallic acid released by tannase to give dark, cold water soluble pigments.

25 Alkaline Treatment Process

In another embodiment of the invention a cold soluble tea ingredient t is prepared by selective alkaline treatment of black tea leaves. The alkaline treated black tea leaf rapidly infuses in cold water providing color to iced tea beverages and when appropriately mixed in selected amounts with other black teas results in a cold infusible beverage with the full complement of tea flavor and color associated with the corresponding prior art processes. It is important that the particle size of the tea

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ingredient and the resulting leaf tea product be of a suitable size to allow rapid and full infusion in cold water. This alkaline treated product in selected amounts about 5% to 25% then may be added to highly flavored tea about 75% to 95% to produce a cold water infusible tea leaf product with both good color and good taste.

As mentioned above, the alkaline treatment step includes conversion of tea compounds to highly colored species.

10

In this embodiment, it is found that tea leaf products which are capable of producing a high quality tea beverage upon brewing with either cold or hot water and which have a substantially reduced level of cold water insoluble solids are obtained by contacting black tea leaf with alkali, thereafter, neutralizing the alkali with acidic reagents, drying the leaf and combining it with selected highly flavored teas.

The resulting leaf tea blends produce beverages prepared from cold water which have a full measure of the organoleptic properties of prior art tea leaf products brewed with hot water. The products of the invention have the unique property of producing high quality tea beverages when brewed with cold water, whereas prior art conventional tea leaf products are only poorly extracted by cold water. For this reason, prior art tea leaf products require boiling water to prepare a full-flavored beverage.

Particle size control is necessary for non alkaline treated leaves and desirable for alkaline tea to break up agglomerated particles treated; a minimum size is required so it does not dust through tea bags and produce haze. Flavor and color of the tea are improved with decreasing particle size as shown in Figure 5.

30

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This second embodiment of the invention will now be described in Example 2.

5 EXAMPLE 2

10 In this Example, color was measured using the Hunter Lab DP 9000 with a sample path length of 5 cm. The color was analyzed by means of the L value. Control values refer to the color before treatment.

The Alkaline Treatment Process and a test procedure to evaluate the final product is given below.

15

| <u>Materials:</u> | <u>Quantity:</u> |
|----------------------|------------------|
| Tea leaf | 20 lbs. |
| 45% KOH | 12 lbs. |
| Water | 9 lbs. |
| 95.7% Sulphuric Acid | 3.7 lbs. |
| Water | 9.0 lbs. |

Procedure

20 The KOH and water were mixed and the diluted caustic solution was added to the 20 lbs. of tea leaf. The slurry was mixed well. The temperature of the leaf was raised to 77° C and the slurry was aerated and mixed well for five minutes. 3.7 lbs. of sulfuric acid was mixed with 9 lbs. of water and added to the alkaline
25 oxidized leaf to neutralize it. The neutralized leaf was dried to about 3 to 7 % moisture at about 70° C.

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Product Evaluation

2.27 grams of dry Alkaline Treated Leaf was added to a 300 ml beaker and 200 ml of 15° C tap water was added to the beaker. The
5 slurry was stirred several times every minute for five minutes and the leaf was separated from the extract by filtration through tea paper. A one-quarter dilution of the extract was prepared by mixing 50 ml of the extract with 150 ml of tap water. The diluted extract was then evaluated with a Hunter Colorimeter.

10

A Hunter L value of about 15-25 and a Hunter "a" value of 20-25 should be obtained for this sample.

15 EXAMPLE 3

A series of tests were run to evaluate the cold infusion Hunter L value of a broad sampling of teas. The alkaline treated tea of the invention was compared for color and produced an
20 overwhelmingly better color.

The teas were brewed and their Hunter L values are presented in Table 2 below.

25

TABLE 2

| Sensory Code | Sample | Hunter L Value |
|--------------|-----------------------|----------------|
| 124 | Tetley® North | 51.2 |
| 136 | Luzianne® Cup | 71.6 |
| 251 | Lipton® Cup | 62.1 |
| 583 | Salada® | 61.1 |
| 685 | Red Rose® Cup | 60.1 |
| 692 | Tetley® South | 71.1 |
| 856 | Lipton® Family | 65.4 |
| 000 | Alkaline treated tea* | 23.2 |

* This sample contained 17.5% Alkaline Treated tea and 82.5% non-treated highly flavored teas.

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The "cold infusion" Hunter L Value is a measurement of color obtained by adding 2.27 gram of tea leaves in a bag to 200 ml of carbon filtered tap water at 15° C and infusing the bag for five minutes with occasional stirring. Separating the bag from the liquid extract, adjusting the pH to 5.0 with dilute H₂SO₄, diluting 50 ml of the extract to 200 ml with deionized water and measuring in a Hunter DP 9000 Colorimeter. Other parameters were described earlier in the Q.D.A. analysis above where the alkaline treated tea is designated number 2 from Table 1.

The tea of Example 3 was placed in a bag and used to prepare fresh brewed iced tea using a cold water infusible black tea leaf bag that delivers the equivalent flavor and color of hot-brewed iced tea. The cold water infusible tea bag contains 82.5% highly flavored teas having smaller particle sizes so that they infuse more easily and quickly in cold water and 17.5% alkaline oxidized tea to boost the color.

A preference test was conducted comparing iced tea made using the cold water infusible tea bag (brewed for 5 minutes using 60° F water and cooled to 40° F) to iced tea made from commercial Lipton® family size tea bags (hot brewed for 3 minutes and cooled to 40° F). The respondents were given the option of putting the additives they normally put into fresh brewed tea (lemon, sugar, and aspartame). No significant differences in "liking scores" were detected between the cold water infusible tea and the hot brewed Lipton iced tea. Both samples were rated slightly above "like slightly" and 31 respondents preferred the hot brewed iced tea compared to 18 preferring the cold brewed iced tea.

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Sample information

| Sample | Variable |
|---------|-----------------------------------------------------------------------|
| Control | Iced tea made with Lipton® Family Size tea bag 3 minute hot brew |
| Test | Iced tea made with Cold Water infusible tea bag 5 minute cold brew |

5

Sensory method

Samples were evaluated in a preference test by 49 in-house employee users/acceptors of iced tea made from tea bags. Samples were served in clear plastic cups and presented in the booths under white lights, using balanced presentation orders. Respondents were given the option of adding lemon, sugar, or aspartame to the tea.

15

TABLE 3

Iced tea made from tea bags COLD BREW BLEND
vs HOT BREW TEA from LIPTON® family or pitcher bag

Acceptability/Preference Test Results* (n=49)

20

| | Sample | Mean Rating | # Preferring |
|---------|----------------------|-------------|--------------|
| Control | Hot Brew Lipton Bags | 6.5 | 31 |
| Test | Cold Brew Tea Bags | 6.1 | 18 |

*No significant differences between the samples for acceptability or preference at the 95% level of confidence.

25

Scale: 9=Like extremely, 8=Like very much, 7=Like moderately, 6=Like slightly, 5=Neither like or dislike, 4=Dislike slightly, 3=Dislike moderately, 2=Dislike very much, 1=Dislike extremely

30

Based on the acceptability scores, it can be concluded that there are no significant differences between iced tea prepared using Cold Brew tea bags and hot-brewed Lipton iced tea in "liking scores".

EXAMPLE 4Instant Tea Coating Method

5 A third and less preferred method of preparing cold infusion tea is to treat standard tea leaves with instant tea powder or to coat the tea leaves with tea extracts. Instant tea powders or solutions may also be employed alone or in combination with other colorants but these products would not be considered 100% leaf tea
 10 formulations. Depending on the manufacture of the powder or tea concentrate, low amounts as well as high amounts of these tea ingredients may be added in sufficient quantities to provide color of a typical hot brew tea product. Products made by this method are expected to have a less preferred flavor.

15

This is illustrated in the table 4 below:

TABLE 4

| | Control | Commercial Instant 1 | | | Commercial Instant 2 | | |
|---------------------------------|---------|----------------------|--------|-------|----------------------|--------|-------|
| Wt. Instant Powder added to bag | 0.00 | 0.1gm | 0.15gm | 0.2gm | 0.1gm | 0.15gm | 0.2gm |
| Hunter L value | 49.6 | 34.9 | 23.9 | 20.1 | 35.7 | 33.0 | 32.4 |
| Hunter a value | 16.2 | 28.9 | 29.0 | 27.3 | 22.9 | 22.5 | 30.3 |
| Hunter haze | 10.4 | 14.7 | 19.3 | 22.2 | 26.9 | 34.2 | 40.5 |

20

All samples are brewed in tea bags using 2.27 grams of tea per bag. Bags are brewed at 15°C for 5 min. in tap water of 170-180 ppm hardness using a LA Motte test kit.

25 As is clear from the foregoing, various modifications of the present invention may be made without departure from the spirit

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and scope of the disclosure, and the invention may be practiced suitably in the absence of elements not specifically disclosed herein.

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CLAIMS

1. A cold brew tea beverage prepared by the cold brew method said beverage having taste and color parameters so that
 - 5 i. when a Q.D.A. test is performed evaluating Bitter2 and Red, and
 - ii. when Bitter2 is plotted on a Q.D.A. map as the Y axis and red is plotted on said map as the X axisthe beverage has a Q.D.A. score on or above the line defined by:
10 $\text{Bitter 2} + 0.639 \text{ Red} \geq 4.8$
2. A black tea product in either loose or bag form comprising tea leaves which is used to prepare a cold beverage having taste and color parameters so that
 - 15 i. when a Q.D.A. test is performed evaluating Bitter2 and Red, and
 - ii. when Bitter2 is plotted on a Q.D.A. map as the Y axis and red is plotted on said map as the X axisthe beverage has a Q.D.A. score on or above the line defined by:
20 $\text{Bitter 2} + 0.639 \text{ Red} \geq 4.8$
3. A cold water infusible black leaf tea product which when brewed in cold water at a temperature of 20° C or less for about 30 minutes or less produces a beverage having a taste and color
25 profile which is not significantly different by statistics from tea prepared from hot brewed black tea and having a tea flavor, intensity and color not statistically different from iced teas brewed via hot brewing methods.
- 30 4. A cold brew tea beverage according to claim 1 employing only tea leaves which are cold water infusible within the invention and the leaf tea is obtained by macerating green tea leaves, treating the macerated leaves with tannase, fermenting the tannase-treated macerate for a time that is sufficient to generate gallic acid and

- 25 -

theaflavin, continuing the fermentation in the presence of an amount of hydrogen peroxide that is sufficient to activate endogenous peroxidases, and drying the fermented leaf material to yield the cold water infusing leaf.

5

5. Cold infusible tea leaves which when infused in water at about 15° C or less for about five minutes at a water to tea ratio of about 88-105 parts of water to 1 part of tea to produce a beverage having 0.15 to 0.28% tea solids a Hunter "L" value of 25
10 to 45; a Hunter "a" value of 24 to 34 and a Hunter haze of 40 or less.

6. Tea leaves defined in claim 3 having at least 0.15% tea solids; a Hunter "L" value of 25 to 45; a hunter "a" value of 24
15 to 34 and a Hunter haze of 40 or less.

7. A tea beverage prepared from tea leaves said beverage having a Hunter L value of about 25 to about 45; a Hunter a value of about 24 to 34; a Hunter haze value of less than 40 and when
20 plotted on a graph using bitter2 as the Y axis and red as the X axis in the Q.D.A. map having a Q.D.A. score on or above the line defined by $\text{bitter2} + 0.639 \text{ red} \geq 4.8$.

8 A cold water infusing leaf tea obtainable by macerating
25 green tea leaves, treating the macerated leaves with tannase, fermenting the tannase-treated macerate for a time that is sufficient to generate gallic acid and theaflavin, continuing the fermentation in the presence of an amount of hydrogen peroxide that is sufficient to activate endogenous peroxidases, and drying
30 the fermented leaf material to yield the cold water infusing leaf tea as defined in claim 1.

9. A product as defined in claim 8 wherein a vacuum is employed to assist in treating the macerated leaves with tannase.

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10. A product as defined in claim 8 wherein the tannase treatment is carried out under anaerobic conditions.

5 11. A cold water infusing instant tea powder made from the cold water infusing leaf of claim 8.

12. A cold brew tea bag or packet product composed substantially of tea leaves and having substantially no non tea colorants comprising:

10

i) 5% to 25 % of the total amount of said tea leaves being a first component which when infused in cold water will produce a cold infusion Hunter L Value of about 25 to 45, said Hunter L Value being directly proportional to the quantity of said first component; and

15

ii) the balance of said tea leaves being a second component of which 80% to 90% of said component has an unagglomerated particle size of about 180 to 300 microns,

20

the resulting product when infused in cold water for 30 minutes or less produces a beverage having a taste and color profile which is not statistically significantly different from tea prepared from hot brewed black tea and a tea flavor, intensity and color not substantially different from iced teas brewed via hot water boiling methods and a cold infusion Hunter L Value of about 25 to 45.

25

13. A tea bag containing only two types of leaf and having a sufficient amount of alkaline treated leaves but less than 25% to produce a cold infusion Hunter L Value of less than 45 in eight ounces of water at a temperature of 15° C within about 5 minutes.

30

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14. A process for producing a black tea leaf product that brews in cold water about 5 minutes to produce a beverage with the color and flavor of hot-brewed tea, comprising the steps of:

- 5 (a) treating the tea leaves with an alkaline solution comprising water and a food grade base at a temperature and time sufficient to deliver a dark red color having a cold infusion Hunter L Value of less than 25; when less than 25% of such treated leaves were used;
- 10 (b) neutralizing the alkaline treated leaves;
- (c) drying the leaves to a moisture content of below 7% on a leaf weight basis to produce alkaline treated tea;
- (d) blending 5-25% of the alkaline treated tea with 75-95% of highly flavored teas; and
- 15 (e) 80 to 90% of the highly flavored teas passes through 20 mesh (841 microns) and is retained by 50 mesh (300 microns).

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Fig.1.

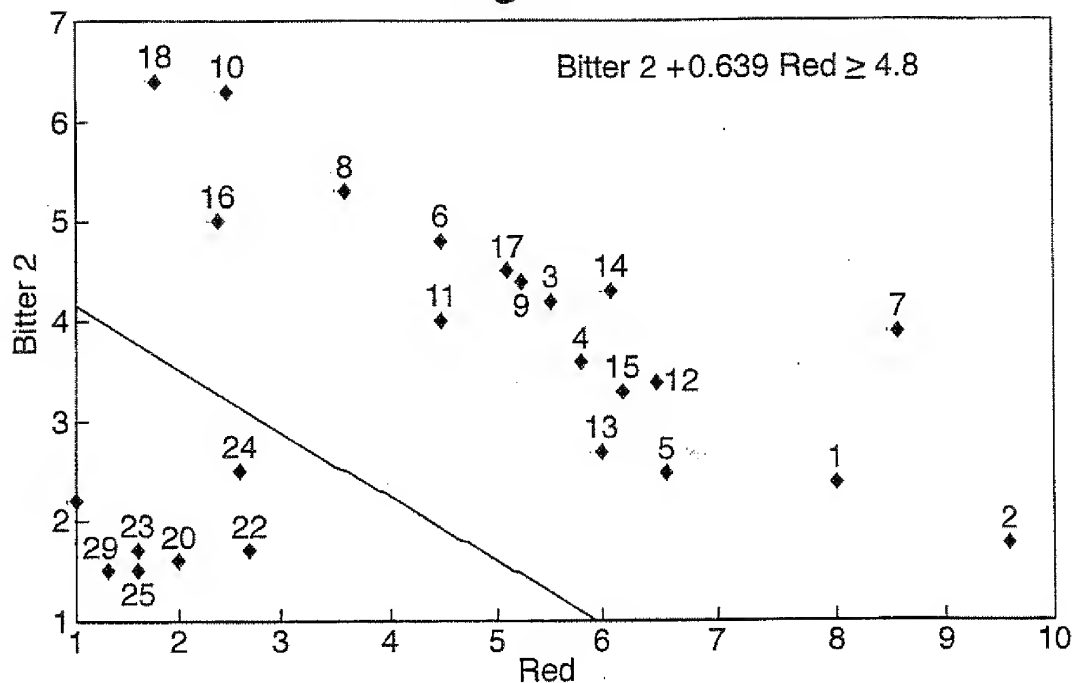
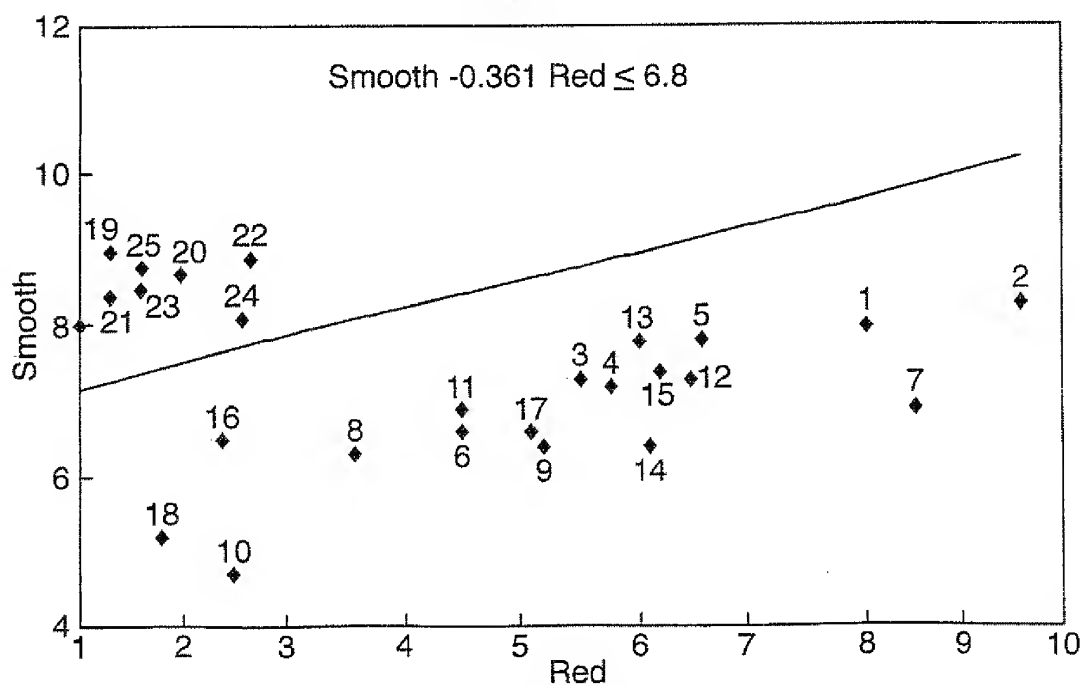


Fig.2.



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Fig.3.

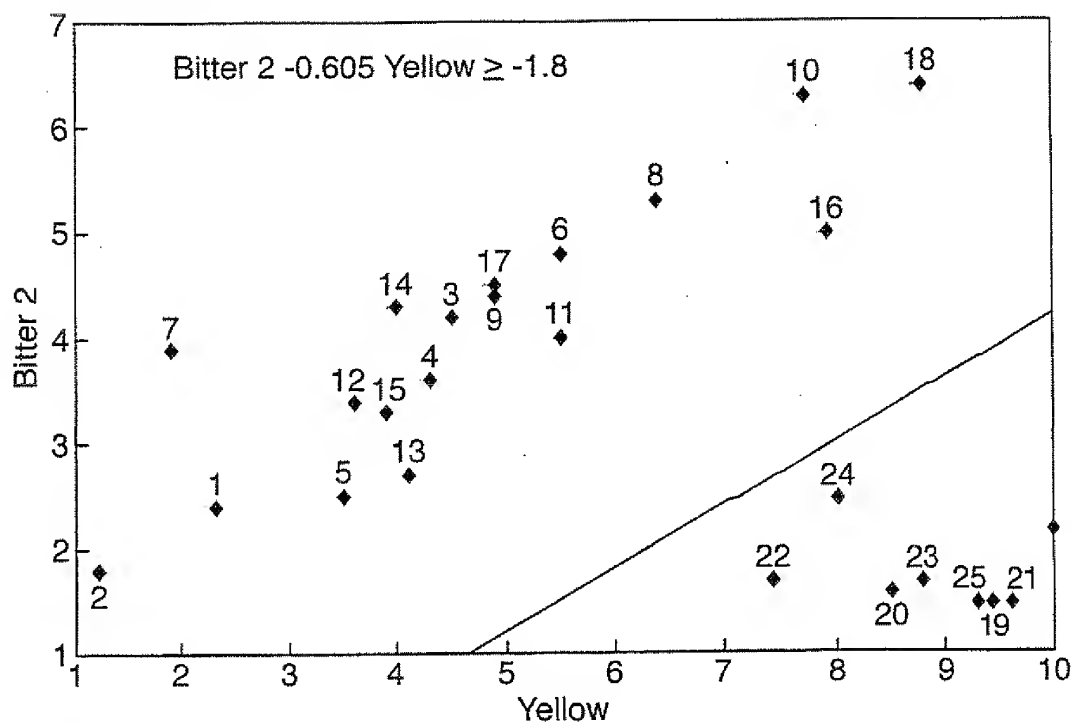
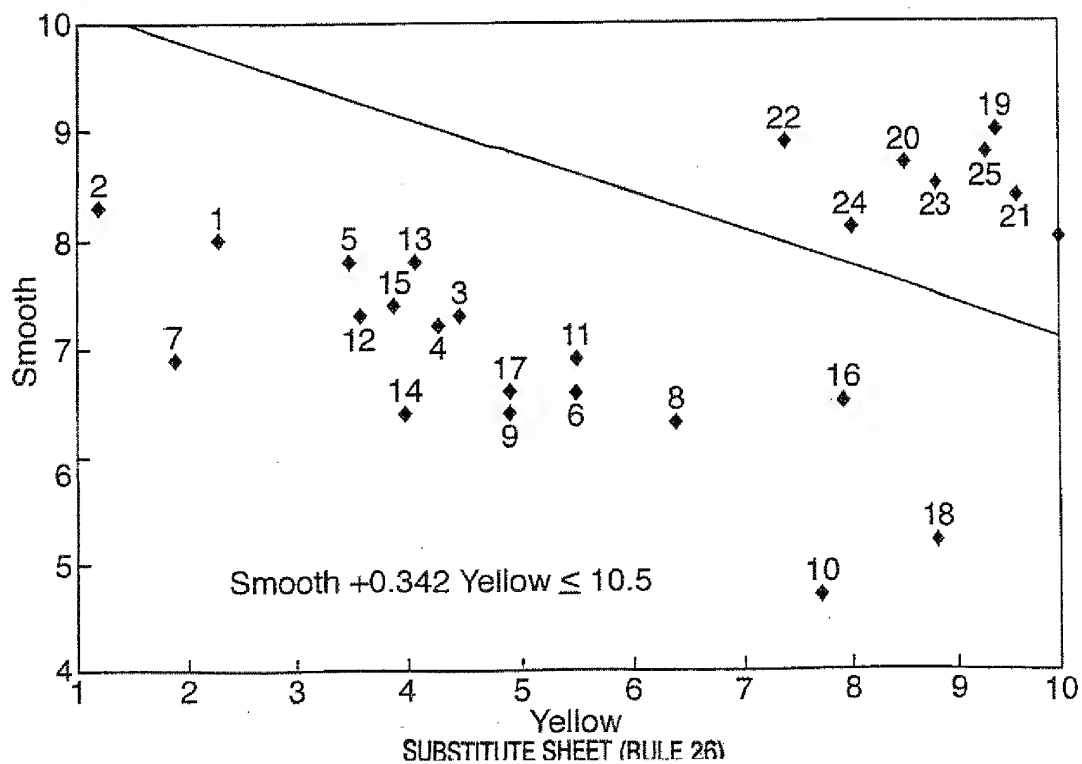
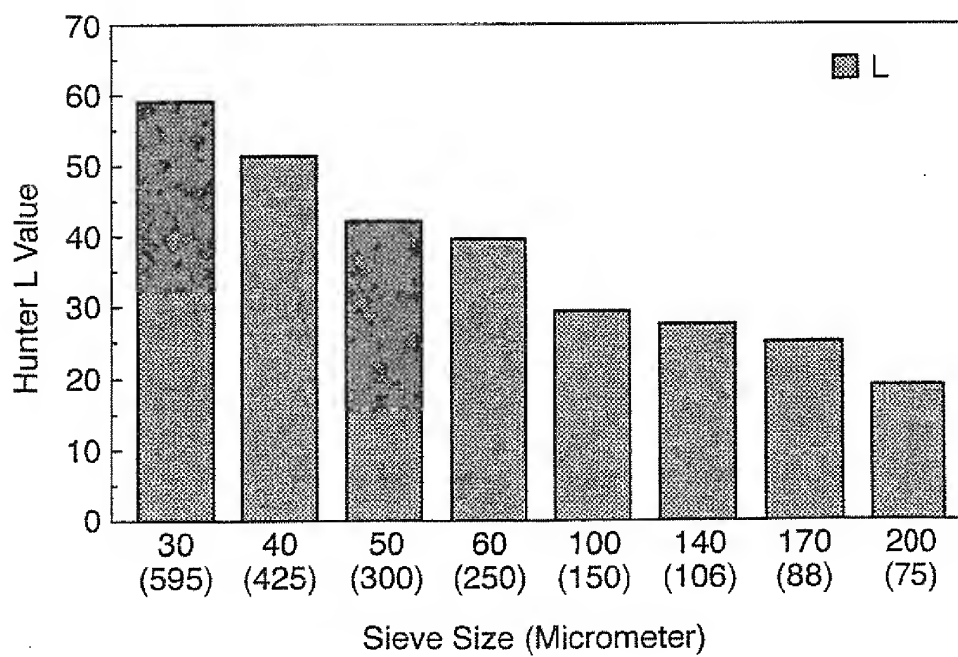


Fig.4.



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Fig.5.



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Published:
— With international search report.

(88) Date of publication of the international search report:
14 December 2000

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: **COLD BREW TEA**

(57) Abstract: A cold water infusible tea leaf product is disclosed which brews in cold water to produce an iced tea beverage with the color and flavor of iced teas prepared by hot brewing methods. The product when brewed in water at about 15 °C for about 5 minutes at a water to tea ratio of 100 water to 1 tea has a cold water infusion Hunter L Value of about 25 to 45; a Hunter "a" value of about 24 to 34; a Hunter haze value of less than 40 and at least 0.15 % soluble tea solids.



WO 00/47056 A3

INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 00/00906

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 A23F3/10 A23F3/14 A23F3/16

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 A23F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

FSTA, WPI Data, PAJ, EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
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| A | column 2, line 3 - line 35; example III | 4,8,10, 11 |
| X | PATENT ABSTRACTS OF JAPAN vol. 014, no. 134 (C-0701), 14 March 1990 (1990-03-14) & JP 02 009341 A (SUNTORY LTD), 12 January 1990 (1990-01-12) abstract | 3,14 |
| X | GB 1 546 508 A (UNILEVER LTD) 23 May 1979 (1979-05-23) | 5,7 |
| A | example II | 13,14 |
| | -/- | |



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

* Special categories of cited documents:

- *A* document defining the general state of the art which is not considered to be of particular relevance
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- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

Z document member of the same patent family

Date of the actual completion of the international search

30 August 2000

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

Inter. Patent Application No.

PCT/EP 00/00906

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| X,P | US 5 919 500 A (GOBBO STEVEN ALPHONSE ET AL) 6 July 1999 (1999-07-06) claim 10; table 1 --- | 7 |
| X,P | EP 0 910 956 A (NESTLE SA) 28 April 1999 (1999-04-28) claims 1-10; examples 1-5 --- | 3 |
| A | US 3 812 266 A (G. SANDERSON) 21 May 1974 (1974-05-21) cited in the application column 2, line 32 - line 52; tables 2,7 --- | 4,7,8, 10,11 |
| A | WO 97 40699 A (UNILEVER) 6 November 1997 (1997-11-06) cited in the application examples 4,7 --- | 3,4,7,8, 10,11 |
| A | EP 0 760 213 A (UNILEVER) 5 March 1997 (1997-03-05) cited in the application claim 1; table 5 --- | 4,7,8, 10,11 |
| A | US 4 639 375 A (CHEE-HWAY TSAI) 27 January 1987 (1987-01-27) column 3 -column 5; claims 1-10; examples 3,4 ----- | 4,7,8 |

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP 00/00906

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 1,2
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
Present claims 1 and 2 relate to a compounds defined (inter alia)
by
reference to the following parameters:
P1: Q.D.A. score

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box I.2

Claims Nos.: 1,2

Present claims 1 and 2 relate to a compounds defined (inter alia) by reference to the following parameters:

P1: Q.D.A. score

P2: Bitter2

P3: red

The applicant's attention is drawn to the fact that claims, or parts of claims, relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1,2,4,8-11

Cold brew tea leaves and cold brew tea beverage defined by the parameters Q.D.A., Bitter2 and Red. Same products defined as product by process: treating macerated tea leaves with tannase, fermentation of the treated leaves in the presence of hydrogen peroxide followed by drying of the fermented leaf.

2. Claims: 3,5,6,12

Cold water infusable tea leaf products providing a cold water infusion having a taste and colour profile not significantly different from hot brewed black tea and from iced teas brewed via hot brewing methods. Cold water infusable tea leaves defined by the parameters Hunter L, Hunter a and Hunter haze of the infusion obtained.

3. Claim : 7

Tea beverage prepared from tea leaves characterised by the following parameters: Hunter L, Hunter a, Hunter haze, Q.D.A., bitter2 and red.

4. Claims: 13,14

Cold water infusable tea leaves containing an amount of alkali treated tea leaves.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PC1/EP 00/00906

| Patent document cited in search report | | Publication date | Patent family member(s) | Publication date |
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